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## PROBLEMATIC ASPECTS OF THE USE OF URBAN UNDERGROUND SPACE IN INDONESIA

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### Abstract

*Recently, the government is taking advantage of underground space for city's infrastructure development needs. In fact, it is identified that the constraints are still remained in fulfilling the government mission. The aim of this paper is to reveal the problematic aspects in terms of the use of underground space by conducting qualitative data in term of interviewing experts and official staff of five local governments' i.e.: Jakarta, Bandung, Surabaya, Makassar, and Medan. It is concluded that the problematic aspects are: the resources, land ownership, legal aspect; underground spatial planning, as well as technical and technological aspects.*

**Keywords:** underground space, utilization, problematic aspects

### INTRODUCTION

The use of urban underground space is being intensively developed in Jakarta, Bandung, Surabaya, Makassar, and Medan. The products of this program i.e.: subway, tunnel, basement parking, infrastructures (telecommunication, gas, electrical, etc.) and sub railway/MRT, in addition to mining and military projects. In the last two mentioned projects, the process and procedures are relatively clear, however, it is different from the other programs in which the use of urban underground space entails many problems.

The problems among others are legal ownership, technological aspect, spatial planning, and resources aspects. Each aspect is complementarily interconnected. Legally, the right and regulation governing spatial plan and underground space are simultaneously formulated along with the construction of these projects. On the contrary, the draft of the regulation concept considered unpublished, therefore, the public does not aware of its existence.

Other problems are the unavailable tools to control or to handle the illegally use of underground space beyond the limit of one's lands right. Technological advances in exploiting the underground space require specific expertise from other developed countries in exploring the underground space in urban areas.

This paper aims to elaborate problematic aspects in setting the use of urban underground space in Indonesia. Interviews and focus group discussion are administered to collect the related information from experts in the fields of geology, civil engineering, urban planning, and land/spatial law as well as the staff of local government whose responsibilities are related to urban underground space.

### THEORETICAL REVIEW

There are related aspects in the use of underground space, are among others, environmental, land ownership, spatial

planning, technical/technological, as well as institutional aspects.

### **1. Environmental aspect**

The environment of underground space contains not only space as a resource but also water resources, mineral resources, fossil and geothermal energy, as well as cultural-historical archaeology.

The underground space in urban areas can be functioned as a place for human activities. For example: transportation (sub railway, subway, basement parking, etc.); general (trade, service, government, and recreation); utilities (drainage, sanitation, water, electrical, telecommunication, etc.); settlement (living, working, and other related to it such as development of room, warehouse, and parking); industry: as well as tourism. In terms of tourism, underground space can be developed to generate the product of tourism industry, and at the same time enjoy the beauty of the underground space.

The underground water resource consists of shallow and deep water which depends on its depth. The underground energy consists of non-renewable energy (oil, natural gas, and coal), nuclear energy, natural radioactive material, nuclear fusion energy, and renewable energy (geothermal). The mineral is the geological resources which are used in industry and it must be viewed as the resources.

“Urban underground space is an important non-renewable resource, and its value has increased in recent decades.” (Ziwei Zhao and Qi Cao, 2011, p 767). However, the use of underground space is not optimally established yet. One of the problematic issues is the conflict in conserving

archeology and using the space for the tunnel. For this, an underground spatial plan is necessary to take into consideration.

Another factor in this aspect is a possible disruption posed by the development of the underground building which can affect the balance of the land surface components. For examples are a disruption in protecting the green zone, an interruption in accessing the underground traffic access to the surface, as well as a disorder in constructing building foundations.

### **2. Land ownership**

Based on the Law and Regulation No. 5/1960 on agrarian principles, the landowners have the authority to use their lands for specific purposes. The limit in exploiting the use of the land surface should comply with the existing regulation. Nevertheless, there is no limitation in exploiting the underground space by the landowner, especially when there are different parties between the owner of the land and the user of the underground space. Therefore, the land right and regulation in using the underground space should be clearly formulated. For example, the rights relinquishment related to the location/site permit: land use plan stated in the master plan: and the guarantee of fixed legal status.

### **3. Spatial planning**

Almost all city plan documents have recommended the utilization of the underground space for transportation and utilities. However, there are no underground guiding for utilizing the spatial underground space within the city and smaller scales. Laws No. 26/2007

about spatial planning and the Government regulation No. 15/2010 about the implementation of spatial planning merely regulates the use of the land surface.

To develop the underground spatial pattern and structure plan in urban area guidance is needed. The underground buildings and infrastructures in Indonesia refer to the Law No. 28/2002 and the Regulation from the Minister for Public Works No. 2/PRT/2014 refers to the guidelines of underground space use.

The Law No. 28/2002, a building is defined as a physical manifestation as the result of construction which unite with its domicile, wholly or partially above and/or under the ground and/or the water surface, which functions as a place for humans doing their activities, for dwelling or shelter, religious activities, business activities, social and culture activities, and special activities such as a nuclear reactor, a defense and security installation, and similar to those which decided by the minister. In this law, there are no rules about utilization of the underground space for the infrastructure of transportation as well as utilities were laid in the layer below and dispatched to the ground.

The regulation of the Minister of Public Works number 02/PRT/M/2014, about the scope of the underground utilization, is based on two criteria, namely, the facilities and the scales of service. Based on the kind of facilities, this regulation only focuses on buildings and infrastructures (transportation and utilities) in urban areas, excluding mining and military facilities. Based on the service scale, there are single building, multi buildings, local area transportation, regional transportation network, local area utilities, and regional utilities.

Based on this regulation, there are two categories of the underground depth regulated, namely: the shallow underground space (until 30 meters under the ground level) and the deep underground space (more than 30 meters under the ground level). The considerations that should be taken into account are by giving more protection and security; by minimizing a disturbance to the ground space and activities attached to it; by maintaining the physical/geological condition of each area; and by optimizing the construction cost.

The division of activities on the depth land exploration as stated in the regulation of the Minister of Public Works No. 2/PRT/2014 are as follows:

- 1) Activities which are acted in the shallow land exploration of 0-30 m cover:
  - a) Activities which must be located near or unite with the ground activities, such as a human crossing tunnel, underpass, local area utility lines, and parking space.
  - b) Activities which need access from and to the underground space with quick manners, such as commercial and amusement buildings.
  - c) Activities which its resources located in the shallow underground space such as buildings with natural lighting;
  - d) Activities, based on the result of the study and/or particular reason, can or must be located in the shallow, and/or cannot be located in the deep, such as living facilities.

- 2) Activities which are acted in the deep land exploration >30m cover:
  - a) Activities which connect to the project of interregional, and/or transmission networks, such as the railway and regional utilities network.
  - b) Activities or goods that need high-security requirement such as dangerous and hazardous material;
  - c) Activities which its resources located in underground space, such as mining facilities; and
  - d) Activities which based on the result of the study and/or specific reason has to be located in the deep and/or cannot be located in the shallow, such as military facilities or defense and security.

In constructing the underground building crossing public infrastructure was set as follows: fit with the spatial plan or the detail plan or the technique buildings and environment plan; not for dwelling; no disturbing the function of underground infrastructure; meet the health requirements according to building function; have special means for the benefit of safety and security for the users of building (Regional Regulation of DKI Jakarta 1/2012 about spatial plan 2030).

#### **4. Technical/technological aspects**

The main focus of this aspect is for the safety in using the underground space relates to the strength of foundation, a disorder in groundwater; sterilization of mineral resources; geological hazardous such as subsidence, slope instability, etc.

The underground space has basic physical characteristics ideally for several kinds of construction because of

a relatively constant condition of its thermal and humidity, as well as covered from light and magnetic power. However, the underground space development has the limitation and specific characteristics so it has to develop carefully and has an effect on using the land surface.

Characteristics of the underground space must consider depth, lifetime, risk level, and function (Gertsch and Bullock, 1998).

- 1) *The depth:* Each country has its own division on the depth in using underground space. There are basic rules for the underground depth (Zaini et al., 2015) namely: a) the greater the depth, the lower the degree of human activity; b) the deeper the building underground, the more stable the temperature and vice versa; c) design of the underground land configuration to address the long-term goals for underground land use (beyond first come, first served); d) different pattern result from different planning goals.
- 2) *Lifetime:* There are activities which use underground space temporarily due to depletion of its resources such as mineral and energy mining and activities which long-lasting or has an unlimited lifetime.
- 3) *Risk level:* The risks include subsidence, slope instability, the collapse of the tunnel, fire, and the explosion from gas bursts, etc. The implication from these risks needs expertise equipment, a technology with high standard, and in turn, need the massive capital.
- 4) *Function:* Factors considered include carrying capacity, environmental safety and public welfare in and around as well as values contained as an economic value, cultural values, and science.

Technical criteria in utilization of the underground space are (Government regulation 36/2005): 1) underground building does not prioritize for dwelling; 2) between underground building and other underground facilities or infrastructure did not quite impair its functions; 3) coefficient of basement tread not exceed the coefficient building tread allowed on the ground; 4) kind of building construction must consider condition of aquifer, geology, disaster characteristics, and the existence of another form of utilization of the underground space; 5) building equipped with the system disaster evacuation; 6) should not put disorder on the floor of building on it and neighbor underground buildings; 7) the underground space must remain to get lighting and the circulation of fresh air.

## 5. Institutional aspect

The institutional aspect particularly related to the licensing. Licensing is a tool to control the utilization of the space so that no cause of negative impacts. Licensing is also as a means to maintain order, justice, and security in the utilization of a space.

In giving a license or a legal permission, we can see in Singapore experience. Legal permission for utilization of the underground space by private is regulated by permission from the expert and the accredited officers. The qualification of the officers/expert was stated clearly in detail according to the depth and kinds of the underground object will be developed ([https://www.bca.gov.sg/BuildingControlAct/building\\_control\\_regulations.html](https://www.bca.gov.sg/BuildingControlAct/building_control_regulations.html)). Meanwhile, only a few cities in Indonesia had a team of experts in giving building permit.

Kinds of licensing in using the land (ground space) in general cities are principle permit, location permit, permission of land utilization, and building permit. A principle permit and location permit are based on the master plan, while permission of land utilization based on the location permit. A detail plan is given based on a building permit and the use of underground space.

## EMPIRICAL PROBLEMS IN USING THE URBAN UNDERGROUND SPACE

The use of urban underground space in Indonesia occurs intensively in metro cities such as Jakarta, Bandung, Surabaya, Makasar, and Medan.

Jakarta is the most intensive and diverse city in using and planning to use urban underground space, including commercial buildings, basement parking, underpass/subway, integrated tunnel, deep tunnel, underground railway (MRT), and utilities (cable network, gas, etc.). While in other cities are still limited to commercial building, basement parking, subway, and underground utilities.

The provincial government has provided rules in giving permission for using the underground space which is based on the following regulations:

- ❑ Regional Regulation of DKI Jakarta 1/2012 about spatial plan 2030; No 1/2014 about detail plan of DKI Jakarta; No. 7/2010 about building;
- ❑ Governor Regulation number 167/2012 about the underground space No. 85/2006 about building permits ordering services.

Jakarta is being the standard to measure the readiness of cities in giving the direction of utilization of the underground space in Indonesia.

Bandung and Medan have a formal detail plan. Surabaya had a technical plan in the past for several zones and needs for the recent ones. Makassar is still composing its detail plan (<http://www.jdih.setjen.kemendagri.go.id/>). The problems still faced by other cities are:

- ❑ There have been no rules on how deep the owner of the land rights has the right to use the underground space.
- ❑ There has been no technical assistance in licensing and utilizing the underground space.

The problems in utilizing the underground space faced by all cities are:

- ❑ Resolution for conflict in using underground resources;
- ❑ Local regulation about the underground space rights for public space and private space;
- ❑ Physical characteristics and/or geological conditions in determining the land depth of underground space;
- ❑ The procedure and division of authority in giving license for using the underground space.

## **ANALYSIS AND DISCUSSION**

Below are the problematic aspects analyzed in setting the use of urban underground space in Indonesia.

### **1) The conflict in using underground resources**

In urban areas, the use of underground space can be conflicted with other underground resources. When conserving archeological resources which retain cultural/historical values, a conflict may arise in exploitation other

resources. Therefore, it needs criteria in terms of data and methods to determine the rules and regulations which should be initiated by conducting a feasibility study in using the underground space.

### **2) The rights to use the underground space by the Landowner**

There are many kinds of land rights that can be assigned and owned by an individual or a collective as well as a legal entity. The land rights provide the power to use the ground and the underground spaces, based on the purposes directly related to the limit according to the Agrarian Law No. 5/1960 and other regulations. In relation to the Agrarian Law, it is stated that there is no rule about the limit of the depth of one's land right. The regulations need to be formulated considering the possible conflicts it may create in line with the increasing demand for the underground space. For example, if local government will build the sub rail network for MRT crossing the land owned by private, the compensation for using the underground space should be determined.

Setting the rules for spatial planning must not only reaches the ground but also the underground spaces. Until now, there is still the problem related to the use of underground space in terms of land rights. The Law No. 5/1960 needs to be revised as it will accommodate the problems faced by the local government.

### **3) The un-readiness of spatial planning product in directing the use of underground space**

Space is a container which includes the land space, the sea water space, and airspace, including the underground space as one whole region, where the

human being and other living creatures do the activities and maintain their survival (Law 26/2007). The Law No. 26/2007 focuses only on the use of land and limits the underground space which attached to the ground such as basement or underpass. To set the use of underground space there is no product of the underground spatial planning which directed to its development. To overcome the problem, local government needs to set the rules and detailed plans relating to the use of underground space.

The master plan document exposes the use of underground space for transportation and utilities without describing the spatial in details. The detailed plan which was derived from the master plan must have the legal bases in three-dimensional uses for underground space.

In the future, the use of underground space will become a conflict if there is no plan involving in the development of several layers of transportation networks and building permits, such as those in other countries. The local government must prepare the guidance because cities such as Jakarta, Bandung, Makasar, Surabaya, and Medan have already utilized underground space in buildings which have several floors below the ground, underground utilities, and transportation network (underpass and MRT).

It needs spatial plan to construct an underground building and to save hazardous materials which must be placed far below the ground that can reach hundreds to thousands of yards. Once an underground building is constructed, it will be hard to revise or reconstruct. So, it needs the three-

dimensional underground spatial plan to avoid the spatial conflict in the future.

#### 4) Feasibility study in technical and technological aspects

The technical consideration in the use of underground space is the feasibility of geological condition; feasibility of civil engineering for the facilities or infrastructures being built; feasibility of ecological and social surrounding location. Geological aspects includes: geology (stratigraphy (lithology/stone/sand), geological structure, technical geology); hydrological condition (groundwater; depth and thickness of an aquifer; the spread of an aquifer; the chemical nature of groundwater/corrosion); potential of disaster (earthquake, subsidence) (Hutasoit, 2016).

Aspects of technical engineering includes the safety of building structure; infrastructures and utilities being built by the depth of the underground space; structural safety for probability of vertical crossing between buildings and infrastructure/utilities in underground space; safety for buildings foundation in underground space based on the height of buildings; technical civil engineering consideration in construction of buildings and infrastructures in underground space. Feasibility of the ecological and social surroundings is needed where the underground space is used for buildings, transportation, and infrastructure (Prakoso, 2016).

After reviewing all the regulations related to the use of underground space, it can be concluded (The directorate general of controlling the utilization of space and tenure of land, 2016) that:



- ❑ Underground buildings have to follow these requirements: suitable with the spatial plan; physical of structures suitable for the safety and healthy requirement according to buildings function; no functional disturbance for facilities and infrastructures located above and/or around; considering geological conditions; legal land status and tenure of land.
- ❑ The underground transportation and infrastructure networks have to fulfill these requirements: suitable with the spatial plan; considering for efficiency, safety, comfort, and harmony with surroundings; no functional disturbance for facilities and infrastructures located above and/or around; considering physical aspect of structures, geological conditions of land and groundwater; legal land status and tenure of land.

Constraints in the technical dimension of utilization of the underground space are: 1) the depth differences among local according to its geological conditions, and technological advanced; 2) no coordination in planning and implementing infrastructures development caused by the irregularity in locating utilities; 3) the absence of structural rule about planning and construction.

- 5) A vacuum of regulation and a lack of human resources

The institutional aspects of utilization of the underground space include the institution and regulation. The problems in institutional aspects are:

- a. No advanced rule about the limit of underground space ownerships as described above;

- b. Cooperation mechanism between the government and the third parties does not have a clear setting;
- c. No advanced rule about the limit of private underground space ownership because of unclear permit on agreement from the landowner;
- d. It needs the rule from central government although there are only several local governments need the land regulation;
- e. Other regulations which are needed to be related to the utilization of the underground space are: solving the conflict between the parties who owned the land and who utilize the underground space; giving permit (the procedures, parties); public infrastructure under the individual land ownership; conflicting or overlapping in sectorial regulations; dividing the authorities among government; dividing of authorities among local institutions related to the utilization of the underground space; the limitation of the underground ownerships; cooperation in utilization of goods owned by states/local with other parties; regulation for underground buildings; structural planning and construction; utilization of the underground space.

Related to the problem of deep limitation of underground space, it is necessary to study from other countries' experience. Initially, Japan has no limitation on how deep the underground space owned by the landowner. Nonetheless, with the higher demand for utilization of the underground space, the underground space owned is being limited only to 40 meters under the ground level for the private use. ([http://www.mlit.go.jp/english/2006/d\\_c\\_a nd\\_r\\_develop\\_bureau/01\\_deep/large2.ht](http://www.mlit.go.jp/english/2006/d_c_a nd_r_develop_bureau/01_deep/large2.ht))



[ml](#); Zaini, 2015). Availability of this limitation is important for local government to manage the utilization of the underground space. The local government of Jakarta undertakes 10 meters under the ground as the limit of private ownership to use the land right. Beyond the limit, it is the authority of local government. Other cities do not determine the regulation yet.

In the draft of land regulation, the central government proposes about giving the right of land and the right of the underground space under the following provisions:

- ❑ Right to use the space is the right to control, use, and take advantage of the land or underground space over control of land ownership on the other lands.
- ❑ Land or underground space owned by other than the owner of land right can be given the right to use the space with the approval of land rights holders.

The absence of arrangement on the right of the underground space leads to the uncertainty. It needs to formulate the rights of the land and the underground space. Also, it needs coordination among institutions in formulating the right of the underground space.

To develop the sustainability of the use of underground space; planning and management of the underground space need to be formulated. Without spatial planning and management for underground space, the implementation of this principle will cause turmoil in the use of underground space which can limit the potential of complicated use for future generations.

## CONCLUSION

To overcome the problematic aspects in the use of urban underground space in Indonesia, it needs efforts as follows:

- a. As a base for development which utilizes the underground space, it needs the underground spatial plan and regulation to its utilization. The future of spatial plan has to include the regulation of underground space used.
- b. The rules and the rights of underground space should also relate to the depth of the limit for the land right.
- c. The underground space is not only used for public interest but also for the private interest which should equip with the technical recommendation and permission to prevent the negative impacts.
- d. Prevent negative impact from the use of the underground space by setting a prerequisite component in the procedure of giving a legal permit to utilize the underground space.
- e. It is necessary to arrange human resources with the expertise required for the development of the underground space.

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